REMARKS/ARGUMENTS

The office action mailed on October 5, 2010, has been reviewed and carefully considered. Reconsideration is respectfully requested.

Amendments to the Claims

Claims 1-18 are now pending in the present application; among them, claims 1, 7, 11, 12, and 18 are independent claims. Claims 1-3, 7, 11-14 and 18 have been amended. No new matter has been added.

Claim Objections

In the office action (page 2), the claims stand objected to because of informalities. In response, the claims have been amended in accordance with the examiner's suggestion and/or comments, which include numbering the claims. The applicants respectfully submit that the claims are now in compliance. Therefore, withdrawal of the aforementioned objection is respectfully requested.

Claim Rejections - 35 U.S.C. §103

In the office action (page 2), claims 1-18 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 7,042,946 (Turaga) in view of U.S. Patent No. 6,141,446 (Boliek).

The applicants have amended claims 1, 7, 11, 12, and 18 to clarify the presently claimed invention.

Comments for 103 Rejection

The presently claimed invention relates to a video coding apparatus and method to **at least two or more temporal inter-frames for a wavelet coding apparatus**, which adjusts computational complexity of a decoding apparatus by controlling a decomposition level and a filter length for a least one of more high passed filtered frames and a final lowpass filtered frame during wavelet transform, which is done for at least two or more temporal inter-frames for wavelet coding for a group of pictures.

Accordingly, the presently claimed invention discloses that when a video signal is

coded in consideration of the computing capability of a terminal, a service optimized for the terminal is provided. That is, the presently claimed invention provides a coding method that adjusts the amount of computation in the inverse wavelet transform such that the amount of computation in the inverse wavelet transform is reduced from a procedure that generally occupies a large computation amount during the decoding process in the inverse wavelet transform. Hence, wavelet transform of the presently claimed invention is carried out based on decomposition levels and the length of a filter that are differentiated for each highpass filter frame according to the characteristics of frames that have gone through MCTF at least two or more times.

Generally, when MCTF is carried out, most video information comes to exist in the lowpass-filtered frames, and the amount of video information in the highpass-filtered frames goes in proportion to the extent of **change of the frames**.

In other words, when the frames are changed a little, most video information exists in the frames lowpass-filtered on the temporal axis, whereas the highpass-filtered frames have little video information. If the frames are changed a lot, much information exists in the highpass-filtered frames.

The frames with a small amount of information barely affect the compression efficiency of the coding apparatus, although the wavelet transforming unit 220 has a low decomposition capability. Therefore, even if a small decomposition level and a short filter length are used to perform wavelet transform, they hardly affect the compression efficiency of the video coding apparatus, which for example means that the lowpass filter frames can have one decomposition level and one type of length of filter and the highpass filtered frames can have an option of selection a smaller decomposition level and a smaller length of filter.

Therefore, the coding apparatus of the presently claimed invention adopts a wavelet filter managing unit 250 to **select a proper filter length from number of filters and a proper decomposition level from various decomposition levels** for the claimed wavelet transform unit (specification, item 220), which is done based on motion estimation information that relates to the **change** of frames (i.e.; for a highpass filtered frames and a final lowpass filtered frame) during at least two or more temporal wavelets filtering of the MCTF, where the wavelet transforming unit of the presently claimed

invention performs spatial wavelet transform based on the selected decomposition level and filter length.

Accordingly, the wavelet transforming unit of the presently claimed invention performs spatial wavelet transform based on the selected decomposition level and filter length, which the selection is made based on the motion estimation information (i.e.; change in frame) **for each of the plurality highpass filter frames and the final lowpass filter frame** of the GOP video computed in the MCTF unit, wherein the decomposition level and the filter length are performed on the spatial wavelets transform for each of the highpass filtered frames and the final lowpass filtered frame, which are also included in the entropy-coded bit stream such that the claimed wavelet managing unit selects a decomposition level and a filter length for the wavelet transforming unit based on motion estimation information of the **GOP, which are obtained by performing the lowpass filtering and the highpass filtering the GOP in the MCTF unit and respectively selects the decomposition level and the filter length for each of the highpass filtered frames and the final lowpass filtered frame such that the selected decomposition level and the filter length for each of the highpass filtered frames are selected properly to the amount of information of each frame based on the motion estimation information so that the decomposition level and the filter length for the final lowpass filtered frame are selected having a maximum decomposition level and a maximum filter length**, which is done with the decomposition level and the filter length included in the entropy-coded bit stream.

The applicants have amended claim 1 (and similarly claims 7, 11, 12, and 18) to clarify these above described aspects of the presently claimed invention, which recites inter alia:

> --a Motion Compensated Temporal Filtering (MCTF) unit for computing **[[a]]** motion vectors of a group of pictures (GOP)**,** and **performing a lowpass** filtering **and a highpass filtering** the GOP with respect to ~~**the**~~ **a first** temporal axis **using the motion vectors**, ~~**to thereby**~~ **in order to** obtain **a lowpass and a highpass** filtered ~~**frame**~~ **frames;**
>
> **wherein the MCTF unit performs the lowpass filtering and the highpass filtering on the lowpass filtered frame of the first temporal axis for at least one or more second temporal axis**;
>
> a wavelet transforming unit for performing spatial wavelet transform

on **each of** the **highpass** filtered ~~**frame**~~ **frames and a final lowpass filtered frame** and outputting **[[a]]** wavelet coefficient**s of each temporal level for each of the highpass filtered frames and the final lowpass filtered frame**;

a quantization unit for quantizing the wavelet coefficient**s**;

an entropy coding unit for entropy-coding the motion vector**s** ~~**computed in the MCTF unit**~~ and the quantized wavelet coefficient**s**, ~~**to thereby**~~ **in order to** generate an entropy-coded bit stream; and

a wavelet filter managing unit for selecting a decomposition level and a filter length for the wavelet transforming unit based on motion estimation information of the GOP**, which are obtained by performing the lowpass filtering and the highpass filtering the GOP in the MCTF unit;** ~~**video computed in the MCTF unit,**~~

wherein the wavelet filter managing unit respectively selects the decomposition level and the filter length for each of the highpass filtered frames and the final lowpass filtered frame;

wherein the decomposition level and the filter length for each of the highpass filtered frames are selected properly to the amount of information of each frame based on the motion estimation information;

wherein the decomposition level and the filter length for the final lowpass filtered frame are selected a maximum decomposition level and a maximum filter length--.

Support for claim 1 (and similarly claims 7, 11, 12, and 18) is found in the specification at least page 13, line 25 to page 16, line 26 and FIGs. 1-4.

The Applicants respectfully submits that the cited references do not describe, teach or suggest all of these limitations recited in amended claim 1 (and similarly claim 7, 11, 12, and 18). Thus, claims 1-18 should be in condition for allowance.

The applicants respectfully submit that nowhere do any of the cited references disclose or suggest each and every one of the limitations recited amended claim 1 (and similarly clams 7, 11, 12, and 18), which selects a decomposition level and a filter length for the wavelet transforming unit based on motion estimation information of the **GOP, which are obtained by performing the lowpass filtering and the highpass filtering the GOP in the MCTF unit and respectively selects the decomposition level and the filter length for each of the highpass filtered frames and the final lowpass filtered frame such that the selected decomposition level and the filter length for each of the highpass filtered frames are selected properly to the amount of information of each frame based on the motion estimation information so that the**

decomposition level and the filter length for the final lowpass filtered frame are selected having a maximum decomposition level and a maximum filter length, which is done with the decomposition level and the filter length included in the entropy-coded bit stream.

In contradistinction, Fig. 4 of the present claimed invention shows a video coding apparatus when the GOP is 8 as follows.

> "As shown, GOP video inputted by the MCTF unit 210 are filtered into t-H frames 111, 112, 113 and 114 of a first temporal level, t-LH frames 121 and 122 of a second temporal level, and a t-LLH frame 132 and a t-LLL frame 131 of a third temporal level.
>
> Generally, **since the t-LLL frame 131 has a large amount of information, the wavelet transform is performed by using a first wavelet transformer 410 having a maximum decomposition level and a maximum filter length. Desirably, the wavelet transformer 410 uses a 9/7 filter or a 5/3 filter that has a three or four-stage decomposition level**.
>
> The t-LLH frame 132 of a third temporal level is wavelet-transformed by a second wavelet transformer 412 and the t-LH frames 121 and 122 of the second temporal level is wavelet-transformed by a third wavelet transformer 414.
>
> Also, the t-H frames 111, 112, 113 and 114 of the first temporal level are wavelet-transformed by a fourth wavelet transformer 416.
>
> The wavelet filter managing unit 250 **selects a decomposition level and a filter length for the wavelet transformers 412, 414 and 416** properly to the amount of information of each frame based on motion estimation information obtained through the MCTF process, and it controls the wavelet transforming unit 220. **It is possible to select a decomposition level and a filter length that make the second through fourth wavelet transformers 412, 414 and 416 to be equal to or smaller than the first wavelet transformer 410.**
>
> The wavelet filter managing unit 250 can control the decomposition level and the filter length by considering the computing capability of a decoding apparatus so that the decoding apparatus could have an optimum computation amount. **In particular, each of the wavelet transformers 412, 414 and 416 can use a Haar filter having a one-stage decomposition level to minimize the decoding computation of the decoding apparatus**.
>
> **The wavelet filter managing unit 250, also, includes information on the selected decomposition level and the filter length in a coded bit stream and uses the information during inverse wavelet transform**.
>
> After the wavelet transform is completed, wavelet transform coefficients of each temporal level are inputted to the quantization unit 105

> and quantized. The quantized wavelet transform coefficients and motion vectors are inputted to the entropy coding unit 240 to thereby generate bit stream",

(specification page 15, line 10 to page 16, line 26 and FIGs. 1, 2, and 4 [**emphasis** added]).

As a result, the presently claimed invention discloses a technology for controlling the computation amount of inverse wavelet transform in the course of decoding process by having the option to adjust the decomposition level and the filter length of a wavelet transform filter of each of a plurality of highpass filtered frames from at least two or more temporal inter-frame wavelets, which each of the selected decomposition level and the filter length for the respective highpass filtered frame of the respective temporal inter-frame wavelet is based on the amount of information of video coding processed by the respective temporal inter-frame wavelet.

Therefore, the presently claimed invention allows inter-frame wavelet decoding in a terminal having low computing capability such as for example a PDA by adjusting the decomposition level and filter length of a wavelet transform filter of each of the highpass filtered frames and the final lowpass filtered frame, which is done in consideration of the computing capability of a decoding apparatus.

Additionally and in general, the current Office Action makes various statements regarding the pending claims and the cited references, which the applicants respectfully believe are now moot in light of the above amendments to claim 1 (and similarly claims 7, 11, 12, and 18). Thus, the Applicants will not address such statements at the present time in order to minimized the time for the examiner's to have to respond to such statements, and which has been do to expedite the examiner's time for responding to Applicants' argument.

However, the Applicants expressly reserve the right to challenge such statements in the future should the need arise (e.g., if such statement should become relevant by appearing in a rejection of any current or future claim). The Applicants also reserve the right to argue additional reasons beyond those set forth above to support the allowability of any claims should such a need arise.

Therefore, the applicants respectfully submit that nowhere does Turaga nor

Boliek, neither alone nor in combination, discloses or suggests each and every one of the limitations of claim 1 (and similarly amended claims 7, 11, 12, and 18), recited above.

DEPENDENT CLAIMS

The other claims are dependent from either independent claim 1 or independent claim 7 or independent claim 12 discussed above for claim 1, where claims 7, 11, 12, and 18 recite similar features to those recited in claim 1. Thus, independent claims 7, 11, 12, and 18 are therefore also believed patentable for at least the same reasons mentioned above for claim 1. Since each dependent claim is also deemed to define an additional aspect of the invention, the dependent claims are also believe patentable, however, the individual reconsideration of the patentability of each of the dependent claims on their own merits is respectfully requested.

Conclusion

For the reasons set forth above, the applicants respectfully submits that claims 1-18, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter.

This amendment is considered to be responsive to all points raised in the office action.

Should the examiner have any remaining questions or concerns, the examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve those concerns.

Respectfully submitted,

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